S5 PROJECT: HIGH-RESOLUTION MULTI-DISCIPLINARY MONITORING OF ACTIVE FAULT

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DPC-INGV
Seismological Projects

RU03 | WP 2.1-2.2: **DEPLOYMENT OF AN ON-LAND, OFF-SHORE SEISMIC NETWORK TO BUILD UP AN INTEGRATED SEISMIC DATA ARCHIVE**

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ABSTRACT

A passive seismic experiment to monitor the Messina Strait and the whole Calabrian arc began in October 2007 and it is still in progress. Overall about 16 temporary seismic stations were installed on land around the the Strait of Messina and 5 ocean bottom seismometers (OBS) to better monitor the area largely covered by the sea. The network incorporates and upgrades existing seismic stations (more than 20) of the permanent networks located in area.

All the data gathered in the Messina 1908-2008 project together with all metadata will be archived in the same SEED data bank and will be accessible by the whole scientific community trough an ArcLink server.'s assemblage of a database and integration of innovative technologies could transform our understanding of the crust and mantle structure of the active tectonics and seismic hazards of the Strait of Messina.

THE RESEARCH PROJECT

To mark the centennial anniversary of the 1908 earthquake that shook Messina, Italy, the Istituto Nazionale di Geofisica e Vulcanologia (INGV) has begun the "Messina 1908-2008" research project.

THE GOALS

Clarify the extension deformation there by merging existing data and studies and by collecting new and more detailed seismological, geodetic, historical and satellite observations.

THE LAND-SEA EXPERIMENT

More than 20 permanent seismic stations and 16 temporary stations, were installed at the end of 2007 [Moretti et al., 2008]. In addition, during the summer of 2008, 5 ocean bottom seismometers (OBS) were deployed to better monitor the area largely covered by the sea [D'Anna et al., 2008; 2009] .

The passive seismic experiment to monitor the Messina Strait and the whole Calabrian is still in progress [Margheriti et al., 2008].

FIGURE 1

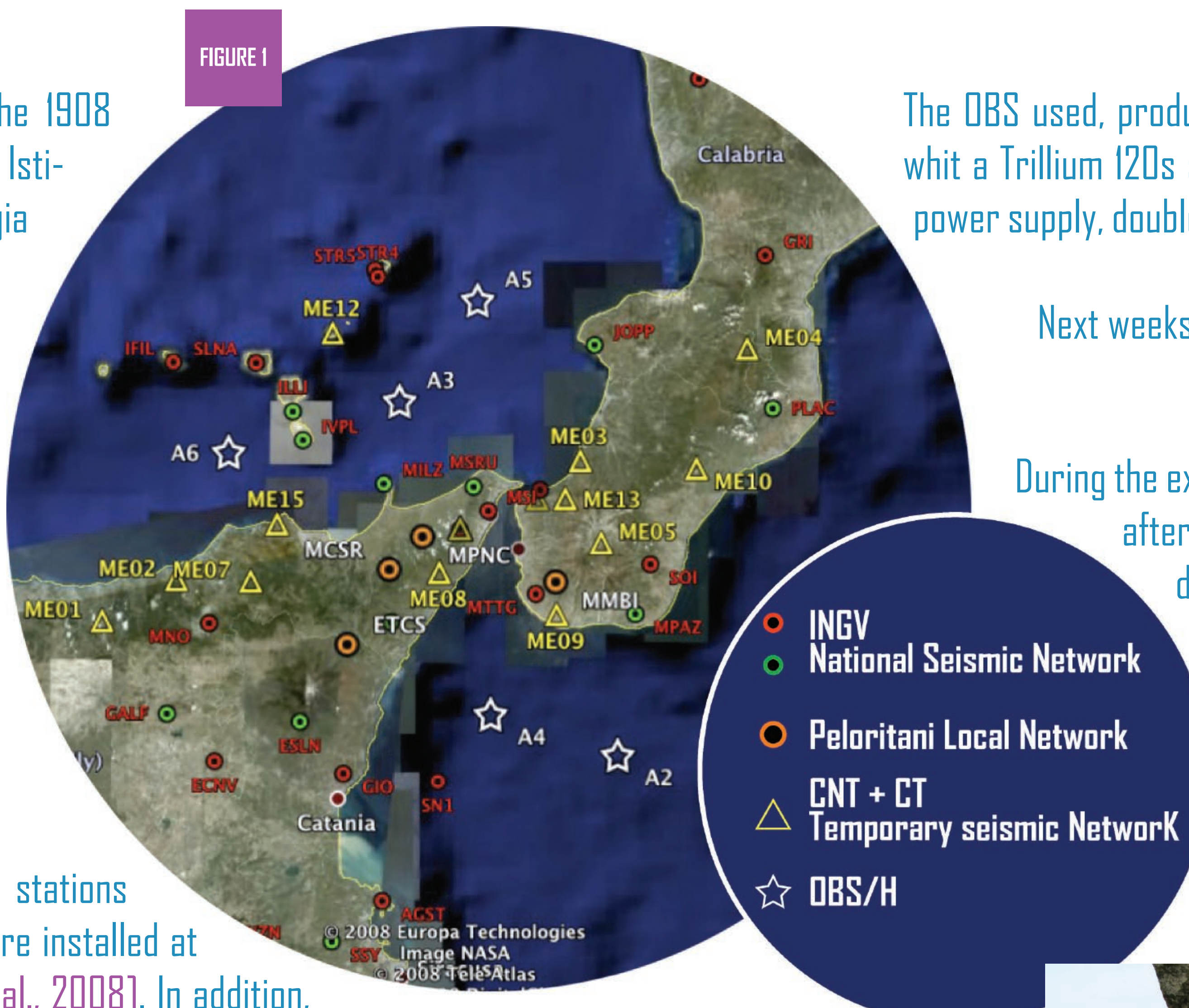


FIGURE 1 - The map of the land-sea temporary seismic network.

TABLE 1 - List of stations of the temporary seismic network (TN = Land network; OBSt = OBS network).

FIGURE 4 - Schetch of the data sources and the role of the data servers in the process of archive building.

TABLE 1

Sign	Location	IN/OUT	Digitizer	Sensor	Net
ME01	Mistretta (ME)	18.10.07/03.02.09	Reftek130	Le 3d-5s	TN
ME02	San Fratello (ME)	19.10.07/03.02.09	Reftek130	Le 3d-5s	TN
ME03	Palmi (RC)	20.10.07/-----------	Reftek130	Le 3d-5s	TN
ME04	Brognaturo (VV)	21.10.07/29.06.08	Reftek130	Le 3d-5s	TN
ME05	Diga Del Menta (RC)	22.10.07/-----------	Reftek130	Le 3d-5s	TN
ME06	Antenna a Mare (ME)	15.11.07/13.05.08	Reftek130	Le 3d-5s	TN
ME07	Castell'Umberto (ME)	22.11.07/13.05.08	Reftek130	Le 3d-5s	TN
ME08	Mali (ME)	08.11.07/-----------	Reftek130	Le 3d-5s	TN
ME09	Pentodattilo (RC)	08.11.07/-----------	Reftek130	Le 3d-5s	TN
ME10	Cittanova (RC)	22.11.07/05.02.09	Reftek130	Le 3d-5s	TN
ME11	Novara di Sicilia (ME)	15.11.07/-----------	Taurus	Le 3d-20s	TN
ME12	Panarea (ME)	06.11.07/-----------	Taurus	Le 3d-20s	TN
ME13	Scilla (RC)	08.11.07/08.12.07	Taurus	Le 3d-20s	TN
ME14	Gambarie (RC)	08.11.07/----------	Taurus	Le 3d-20s	TN
ME15	Gioiosa Marea	18.10.07/----------	Reftek130	Le 3d-5s	TN
ME16	Antenna a Mare (ME)	01.09.08/07.02.09	Reftek130	Le 3d-5s	TN
A2	South of Strait of Messina	15.0708/07.11.08	Geolon MLS	Trillium120p	OBSt
A3	North of Strait of Messina	18.0708/07.11.08	Geolon MLS	Trillium120p	OBSt
A4	South of Strait of Messina	15.0708/07.11.08	Geolon MLS	Trillium120p	OBSt
A5	North of Strait of Messina	18.0708/07.11.08	Geolon MLS	Trillium120p	OBSt
A6	North of Strait of Messina	18.0708/07.11.08	Geolon MLS	Trillium120p	OBSt

THE OBS

The OBS used, produced by INGV Gibilmanna Observatory, are equipped whit a Trillium 120s sensor, an hydrophone (DPG band pass 160s- 2 Hz), power supply, double recovery system and acquisition system on a 24 GB Compact flash.

Next weeks, will begin an other campaign OBS until spring 2010.

PROBLEMS AT SEA

During the experiment, one of the OBS malfunctioned and came up after a few days from installation, thanks to a GPS dispodal the OBS A3 was tracked, recovered and reinstalled.

FIGURE 2 - The OBS produced by INGV Gibilmanna Observatory and used during "Messina 1908-2008" experiment.

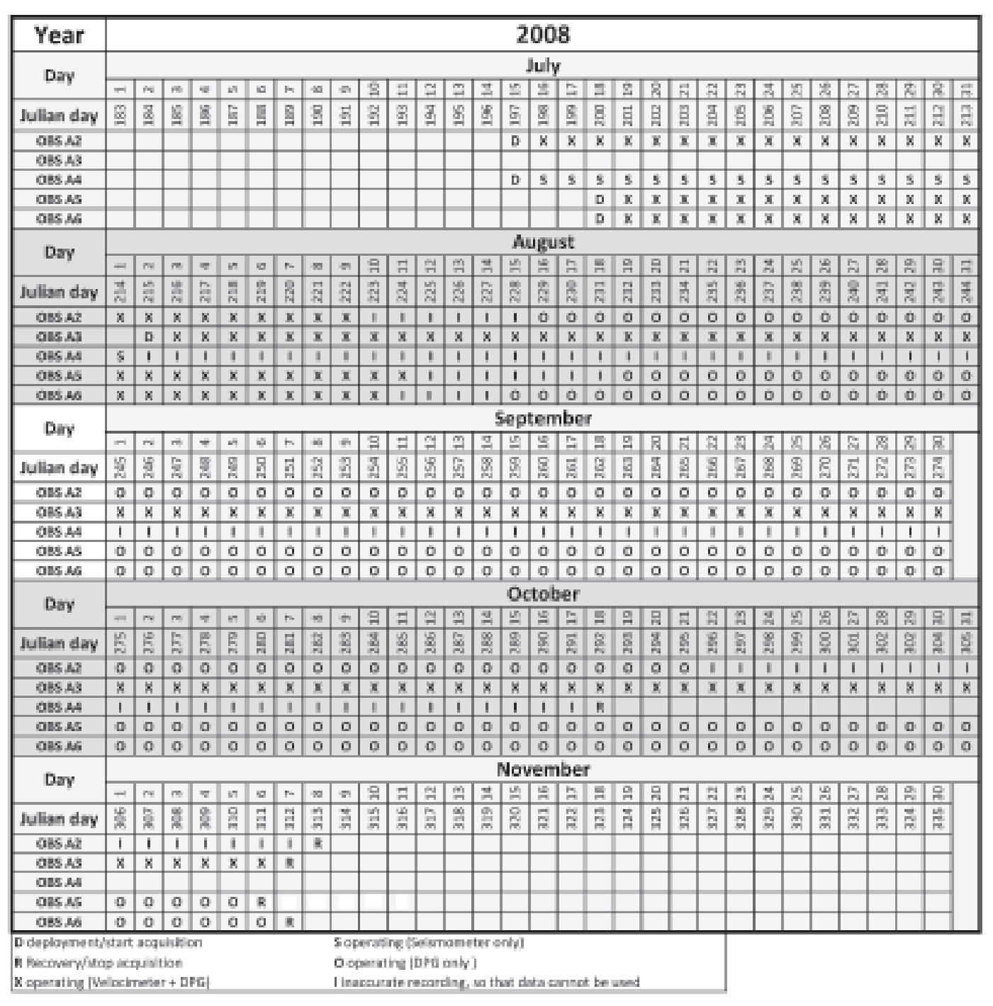
TABLE 2 - OBS data available (July-November 2008).

FIGURE 3 - Exsemples the temporary seismic stations.

TABLE 3 - Seismic network data available.

FIGURE 2

TABLE 2



Year	2008																													
Day	July																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Julian day	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213
OBS A2															D	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
OBS A3																															
OBS A4															D	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
OBS A5																		D	X	X	X	X	X	X	X	X	X	X	X	X	X
OBS A6																		D	X	X	X	X	X	X	X	X	X	X	X	X	X
Day	August																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Julian day	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244
OBS A2	X	X	X	X	X	X	X	X	X	I	I	I	I	I	I	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
OBS A3		D	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
OBS A4	S	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
OBS A5	X	X	X	X	X	X	X	X	X	X	X	I	I	I	I	I	I	I	O	O	O	O	O	O	O	O	O	O	O	O	O
OBS A6	X	X	X	X	X	X	X	X	X	X	I	I	I	I	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Day	September																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Julian day	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	
OBS A2	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
OBS A3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
OBS A4	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	
OBS A5	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
OBS A6	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
Day	October																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Julian day	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305
OBS A2	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	I	I	I	I	I	I	I	I	I	I
OBS A3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
OBS A4	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	R													
OBS A5	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
OBS A6	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Day	November																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Julian day	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	
OBS A2	I	I	I	I	I	I	I	R																							
OBS A3	X	X	X	X	X	X	R																								
OBS A4																															
OBS A5	O	O	O	O	O	R																									
OBS A6	O	O	O	O	O	O	R																								

D deployment/start acquisition
R Recovery/stop acquisition
X operating (Velocimeter + DPG)
S operating (Seismometer only)
O operating (DPG only)
I inaccurate recording, so that data cannot be used

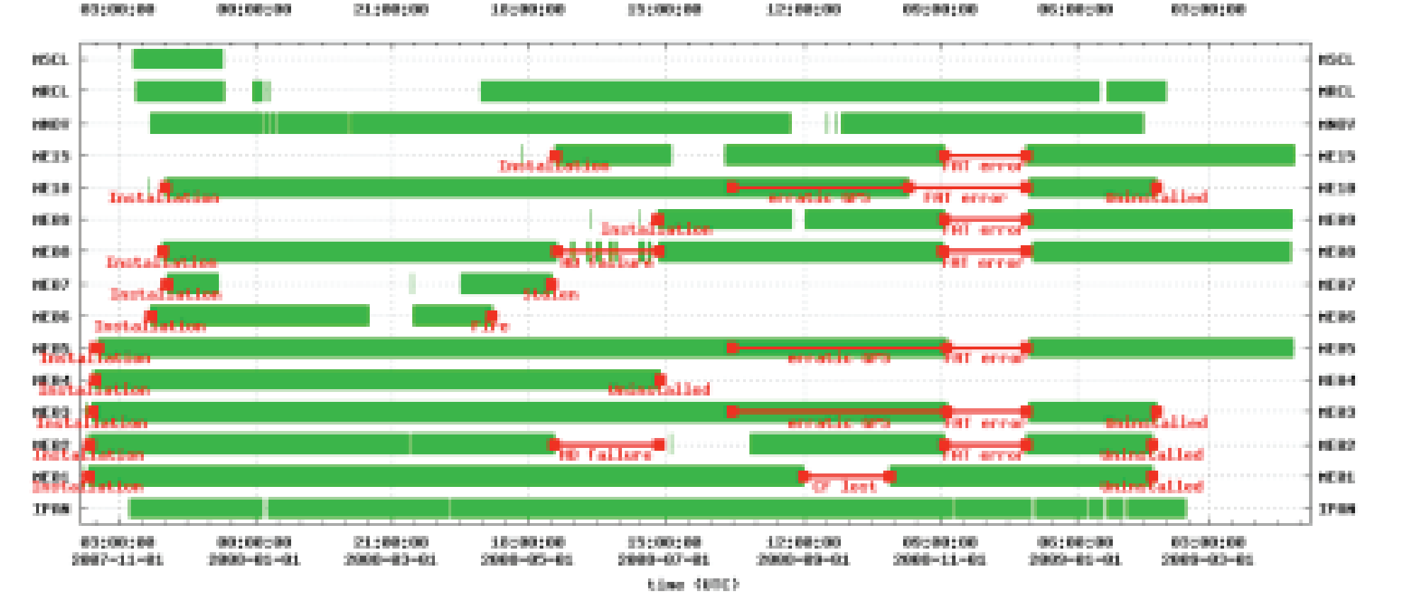
FIGURE 3

THE SEISMIC STATIONS

16 temporary seismic digital stations (Reftek and Nanometrics equipped with three-component sensors Lennartz and Nanometrics) were installed at the end of 2007. The network, covering an area of about 120 km radius centered on the city of Messina. In Table 1 the coordinates and types of instrumentation used.

Since February 2009, remained in use 4 stations waiting the second campaign OBS.

TABLE 3



PROBLEMS IN LAND

During the first year of deployment, we had several problems and damages: one station was stolen, one vandalized and one burned in a fire.

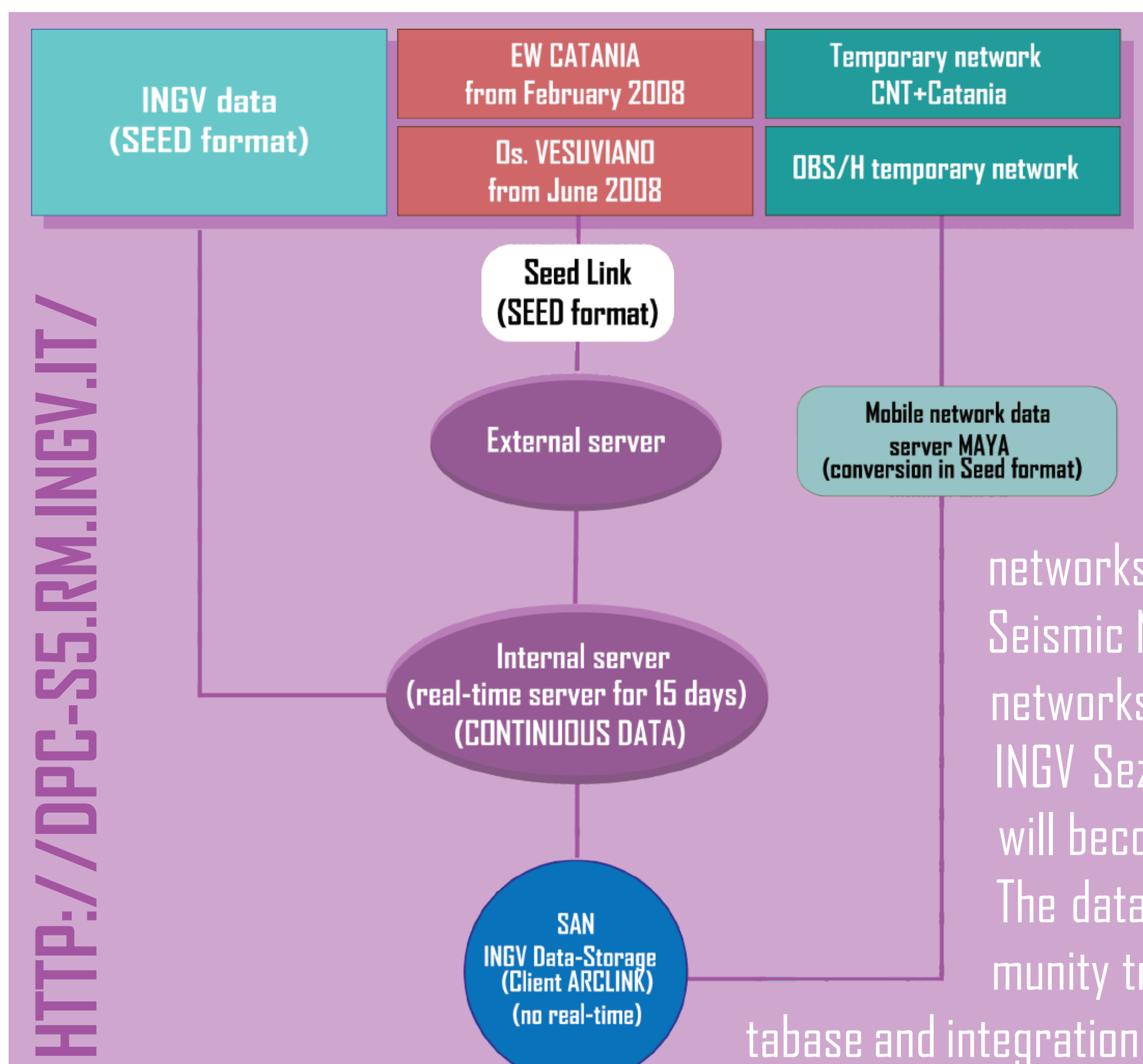


FIGURE 4

WAVEFORM ARCHIVE

One of the goals of the project is the craetion of a waveform archive that will collect, in a uniform format (SEED), recordings of all the available seismic stations present in the region. It will be the fist example of complete integration of data provided by permanent networks (INGV National Seismic Network, Peloritani Seismic Network), temporary deployments (both mobile networks from INGV Centro Nazionale Terremoti and INGV Sezione di Catania) and OBS data, that hopefully will become a standard for INGV seismic experiments.

The data were accessible by the whole scientific community trough an ArcLink server's assemblage of a database and integration of innovative technologies could transform our understanding of the crust and mantle structure of the active tectonics and seismic hazards of the Strait of Messina [Mandiello et al., 2009,

DATA ANALYSIS

Using continuous recording of the integrated network a semiautomatic procedure will define the triggers and the P and S arrivals to locate the seismicity using both conventional and refined techniques.

This automatic stage can be reviewed by seismologist, using the standard tools of the National Network ("SisPick!2" [Bono, 2008; Figure 5a, b, c] for picking and "Locator" [Basili] for hypocentral, boh this tools have been tailored for this task).

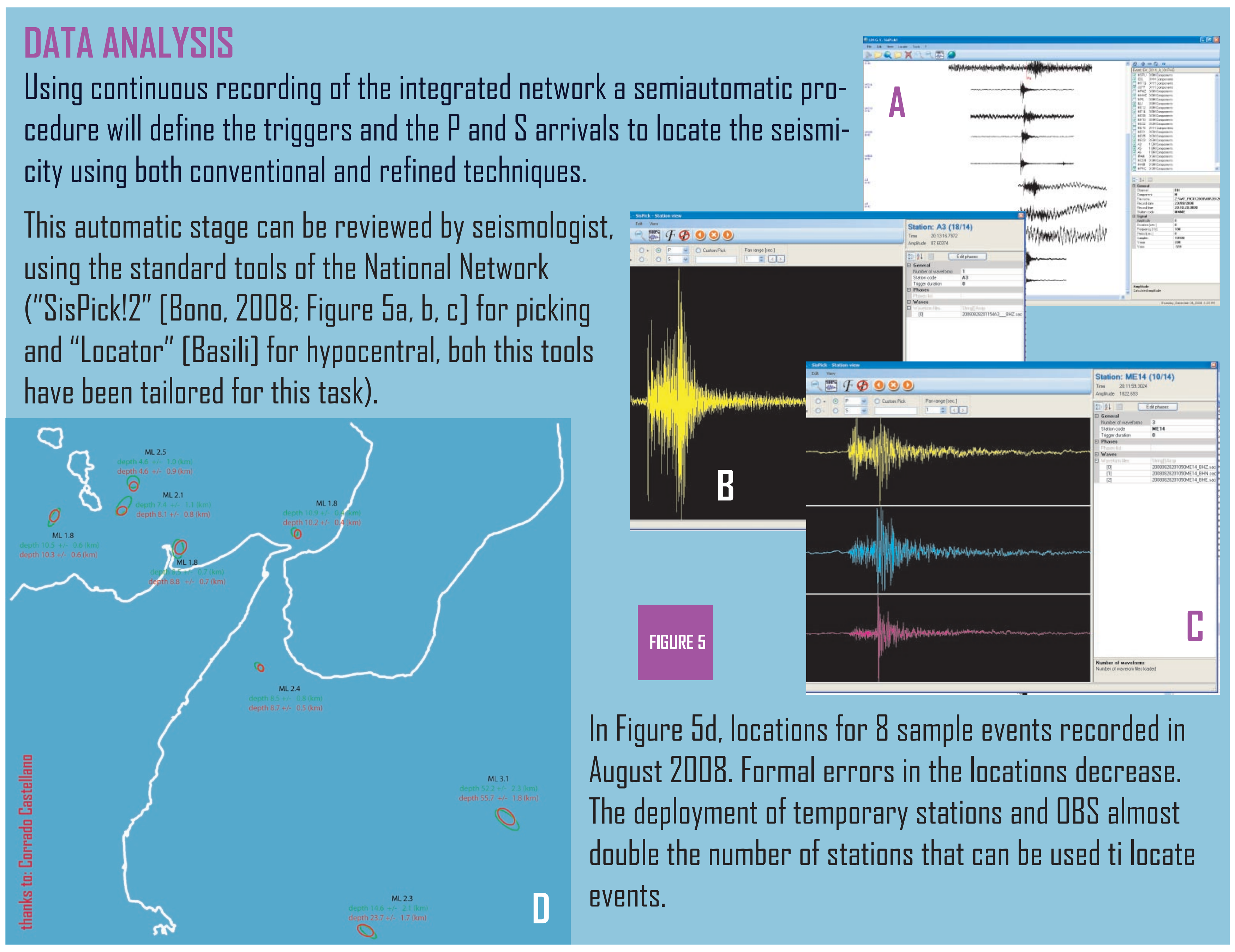


FIGURE 5

In Figure 5d, locations for 8 sample events recorded in August 2008. Formal errors in the locations decrease. The deployment of temporary stations and OBS almost double the number of stations that can be used ti locate events.

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